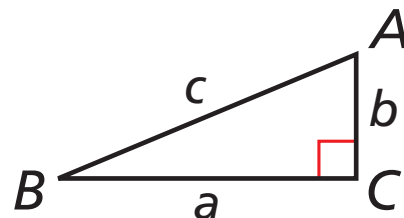


**Attendance questions.** Use the triangle at the right to answer questions 1-3.

1. If  $a = 8$  and  $b = 5$ , find  $c$ . Write your answer as simplified radical.
2. If  $a = 60$  &  $c = 61$ , find  $b$ .
3. If  $b = 6$  &  $c = 10$ , find  $\sin B$ . Write your answer as a fraction in simplest form and a decimal.



**Find AB.** Write your answer as radical in simplified form.

4.  $A(8, 10)$  &  $B(3, 0)$
5.  $A(1, -2)$  &  $B(2, 6)$

- I can solve right triangles.

**Common Core: CC.9-12.G.SRT.8** Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.

San Francisco, California, is famous for its steep streets. The steepness of a road is often expressed as a *percent grade*. Filbert Street, the steepest street in San Francisco, has a 31.5% grade. This means the road rises 31.5 ft over a horizontal distance of 100 ft, which is equivalent to a  $17.5^\circ$  angle. In this lesson we will learn how  $17.5^\circ$  was calculated.



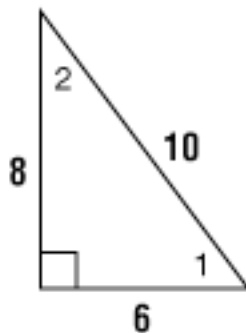
**Q:** Why are you reading that sign backwards?

**A:** It's an inverse sine!

"Take good care of your reputation. It will live longer than you do."—*Unknown*

**Refer to video Example 1:**

Use the trigonometric ratio  $\cos A = \frac{4}{5}$  to determine which angle of the triangle is  $\angle A$ .

**EXAMPLE 1 Identifying Angles from Trigonometric Ratios**

Use the trigonometric ratio  $\cos A = 0.6$  to determine which angle of the triangle is  $\angle A$ .

$$\cos A = \frac{\text{adj. leg}}{\text{hyp.}}$$

*Cosine is the ratio of the adjacent leg to the hypotenuse.*

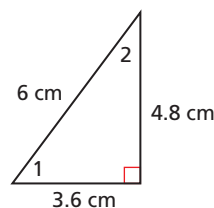
$$\cos \angle 1 = \frac{3.6}{6} = 0.6$$

*The leg adjacent to  $\angle 1$  is 3.6. The hypotenuse is 6.*

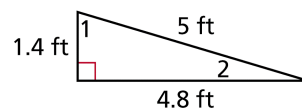
$$\cos \angle 2 = \frac{4.8}{6} = 0.8$$

*The leg adjacent to  $\angle 2$  is 4.8. The hypotenuse is 6.*

Since  $\cos A = \cos \angle 1$ ,  $\angle 1$  is  $\angle A$ .



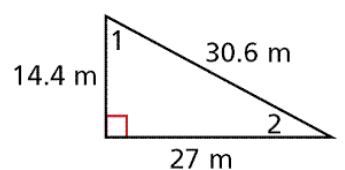
**Example 1.** Use the trigonometric ratio  $\cos A = \frac{24}{25}$  to determine which angle of the triangle is  $\angle A$ .



**Guided Practice:**

6. If  $\sin A = \frac{8}{17}$ , which angle, 1 or 2, is  $\angle A$ ?

7. If  $\tan A = 1.875$ , which angle, 1 or 2, is  $\angle A$ ?



List the exact values the following. Simplify and rationalize all denominators!

8.  $\sin 45^\circ$

9.  $\cos 45^\circ$

10.  $\tan 45^\circ$

11.  $\sin 30^\circ$

12.  $\cos 30^\circ$

13.  $\tan 30^\circ$

14.  $\sin 60^\circ$

15.  $\cos 60^\circ$

16.  $\tan 60^\circ$

16. If you solve a problem and the angle has a sine that is 0.5, what is the measure of the angle?

17. If you know the sine, cosine, or tangent of an acute angle measure, you can use the \_\_\_\_\_ trigonometric functions to find the measure of the angle.

Inverse Trigonometric Functions	
If $\sin A = x$ , then $\arcsin(x) = m\angle A$ , $\sin A = x$ , then $\sin^{-1} x = m\angle A$	
If $\cos A = x$ , then _____ = $m\angle A$ , $\sin A = x$ , then $\cos^{-1} x = m\angle A$	
If $\tan A = x$ , then $\arctan(x) = m\angle A$ , $\sin A = x$ , then _____ = $m\angle A$	

**Trig Calculator:** <http://www.easycalculation.com/trigonometry/trigonometry.php>

**Video Example 2:** Use your calculator to find the angle measures. Round your answer to the nearest degree.

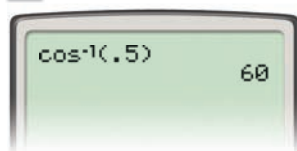
A.  $\cos^{-1}(0.25)$

B.  $\arctan 5.1$

**2 Calculating Angle Measures from Trigonometric Ratios**

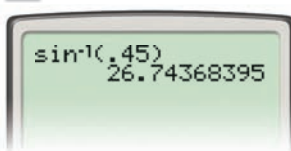
Use your calculator to find each angle measure to the nearest degree.

**A**  $\cos^{-1}(0.5)$



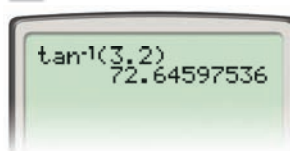
$\cos^{-1}(0.5) = 60^\circ$

**B**  $\sin^{-1}(0.45)$



$\sin^{-1}(0.45) \approx 27^\circ$

**C**  $\tan^{-1}(3.2)$



$\tan^{-1}(3.2) \approx 73^\circ$

**Example 2.** Use your calculator to find the angle measures. Round your answer to the nearest degree.

**A.**  $\cos^{-1}(0.87)$

**B.**  $\arcsin(0.85)$

**C.**  $\arctan(0.71)$

**Guided Practice.** Use your calculator to find the angle measures. Round your answer to the nearest degree.

18.  $\tan^{-1}(0.75)$

19.  $\arccos(0.05)$

20.  $\sin^{-1}(0.67)$

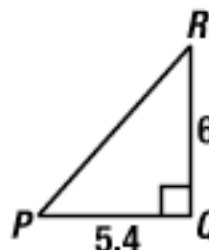
24. What does it mean to solve a right triangle?

25. When you solve a right triangle, round angle measures to \_\_\_\_\_.

26. When you solve a right triangle, round side lengths to \_\_\_\_\_.

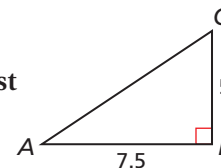
**Example 3:**

Find the unknown measures. Round lengths to the nearest hundredth and angle measures to the nearest degree.



**EXAMPLE 3 Solving Right Triangles**

Find the unknown measures. Round lengths to the nearest hundredth and angle measures to the nearest degree.

**Method 1:**

By the Pythagorean Theorem,

$$AC^2 = AB^2 + BC^2.$$

$$= (7.5)^2 + 5^2 = 81.25$$

$$\text{So } AC = \sqrt{81.25} \approx 9.01.$$

$$m\angle A = \tan^{-1}\left(\frac{5}{7.5}\right) \approx 34^\circ$$

Since the acute angles of a right triangle are complementary,  
 $m\angle C \approx 90^\circ - 34^\circ \approx 56^\circ$ .

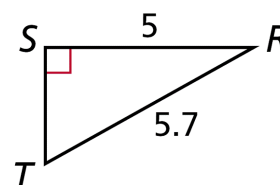
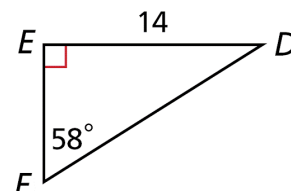
**Method 2:**

$$m\angle A = \tan^{-1}\left(\frac{5}{7.5}\right) \approx 34^\circ$$

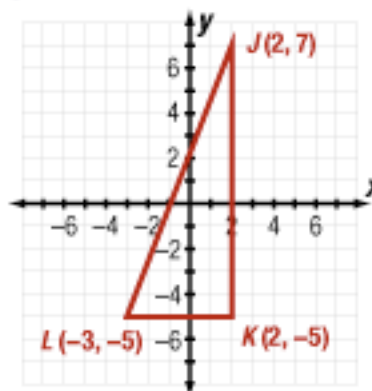
Since the acute angles of a right triangle are complementary,  
 $m\angle C \approx 90^\circ - 34^\circ \approx 56^\circ$ .

$$\sin A = \frac{5}{AC}, \text{ so } AC = \frac{5}{\sin A}.$$

$$AC \approx \frac{5}{\sin\left[\tan^{-1}\left(\frac{5}{7.5}\right)\right]} \approx 9.01$$

**Example 3. Solve the right triangle.****27. Guided Practice. Solve the right triangle.****8-3 Solving Right Triangles: (pp 556) 21, 25, 29, 31, 34, 35.****Video Example 4**

The coordinates of the vertices of  $\triangle JKL$  are  $J(2, 7)$ ,  $K(2, -5)$ , and  $L(-3, -5)$ . Find the side lengths to the nearest hundredth and the angle measures to the nearest degree.



**EXAMPLE 4****Solving a Right Triangle in the Coordinate Plane**

The coordinates of the vertices of  $\triangle JKL$  are  $J(-1, 2)$ ,  $K(-1, -3)$ , and  $L(3, -3)$ . Find the side lengths to the nearest hundredth and the angle measures to the nearest degree.

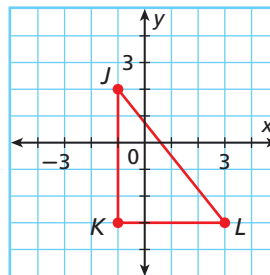
**Step 1** Find the side lengths.

Plot points  $J$ ,  $K$ , and  $L$ .

$$JK = 5 \quad KL = 4$$

By the Distance Formula,

$$\begin{aligned} JL &= \sqrt{[3 - (-1)]^2 + (-3 - 2)^2} \\ &= \sqrt{4^2 + (-5)^2} \\ &= \sqrt{16 + 25} = \sqrt{41} \approx 6.40 \end{aligned}$$



**Step 2** Find the angle measures.

$$m\angle K = 90^\circ$$

$\overline{JK}$  and  $\overline{KL}$  are  $\perp$ .

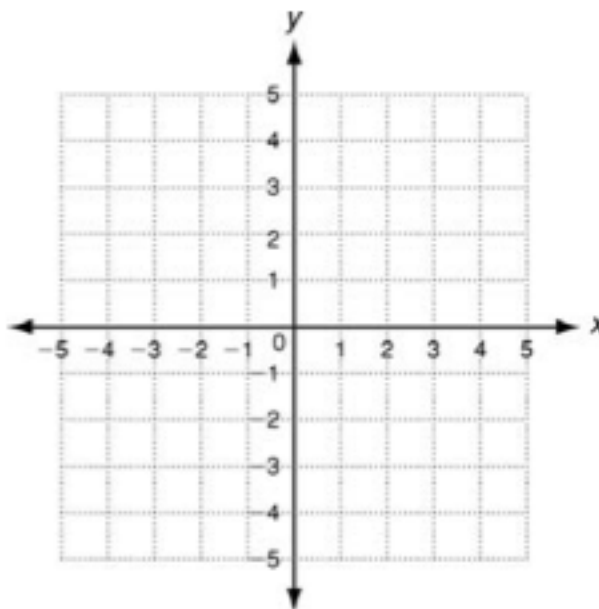
$$m\angle J = \tan^{-1}\left(\frac{4}{5}\right) \approx 39^\circ$$

$\overline{KL}$  is opp.  $\angle J$ , and  $\overline{JK}$  is adj. to  $\angle J$ .

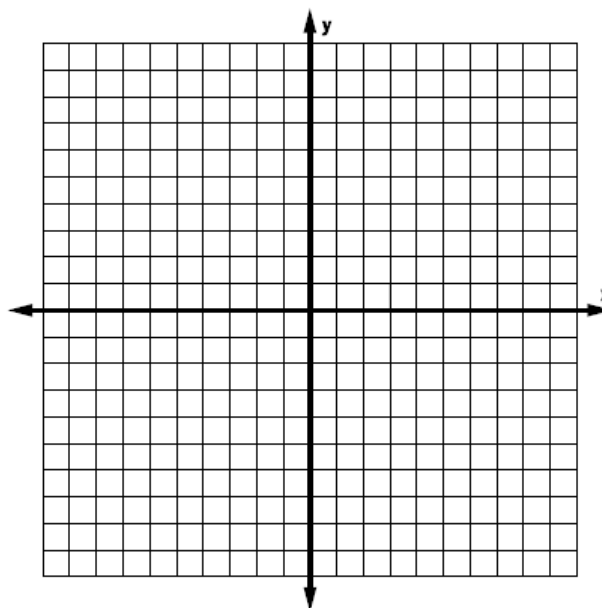
$$m\angle L \approx 90^\circ - 39^\circ \approx 51^\circ$$

The acute  $\angle$ s of a rt.  $\triangle$  are comp.

**Example 4.** The coordinates of the vertices of  $\triangle PQR$  are  $P(-3, 3)$ ,  $Q(2, 3)$ , and  $R(-3, -4)$ . Find the side lengths to the nearest hundredth and the angle measures to the nearest degree.



**28. Guided Practice:** The coordinates of the vertices of  $\triangle RST$  are  $R(-3, 5)$ ,  $S(4, 5)$ , and  $T(4, -2)$ . Find the side lengths to the nearest hundredth and the angle measures to the nearest degree.



### Video Example 5:

If a hill has a percent grade of 52%, what angle does the hill make with a horizontal line? Round to the nearest degree.

#### EXAMPLE

5

#### Travel Application

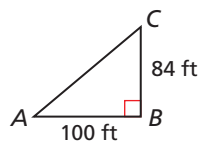
San Francisco's Lombard Street is known as one of "the crookedest streets in the world." The road's eight switchbacks were built in the 1920s to make the steep hill passable by cars. If the hill has a percent grade of 84%, what angle does the hill make with a horizontal line? Round to the nearest degree.



$$84\% = \frac{84}{100}$$

Change the percent grade to a fraction.

An 84% grade means the hill rises 84 ft for every 100 ft of horizontal distance.



Draw a right triangle to represent the hill.

$\angle A$  is the angle the hill makes with a horizontal line.

$$m\angle A = \tan^{-1}\left(\frac{84}{100}\right) \approx 40^\circ$$

**Example 5.** A highway sign warns that a section of road ahead has a 7% grade. To the nearest degree, what angle does the road make with a horizontal line?

**29. Guided Practice:** Baldwin St. in Dunedin, New Zealand, is the steepest street in the world. It has a grade of 38%. To the nearest degree, what angle does Baldwin St. make with a horizontal line?

### **8-3 Solving Right Triangles**

- (pp 556) 21, 25, 29, 31, 34-38, 51, 54, 58, 60, 62, 63.
- 8A Ready to Go On pretest & posttests.

